Quantum Mechanics as Reality or Potentiality from A Psycho-Biological Perspective

F. K. Jansen[1]

Abstract

Quantum mechanics are generally interpreted as physical reality with superposition of wave functions, which have to collapse to observable reality. From a psycho-biological perspective, it could also be interpreted as superposition in the mental representation of reality, which corresponds to imagined potentiality and is naturally replaced by reality, when it becomes observable. The interpretation of quantum mechanics as physical reality entails some weird aspects, such as multiple worlds or environmental decoherence. In contrast, mental potentiality would simply be replaced by observable reality and looses all weird aspects of quantum mechanics. Nevertheless, a reality or potentiality interpretation remains completely neutral with respect to philosophical or religious world views.

Keywords – Quantum Mechanics, thought experiment, uncertainty, wavefunction collapse, mathematical formalism,

Introduction.

Quantum mechanics introduced some weird aspects with respect to classical physics, such as Schrödinger's (1926) superposition of wave functions and Heisenberg's (1927) uncertainty principle. According to Tegmark "*the world is weird, and we just have to learn*

1 F. K. Jansen, a medical working in in France, doctor and researcher delving deep into the mind and matter, immunology and philosophy of Science.

to live with it." (Tegmark 2014, p 228). From the perspective of psychological and biological considerations, the interpretation of quantum mechanics might be different. Observation with human sense organs allows a mental representation of the extra-mental reality world. Thereafter cognitive mental functions transform observations of regularities, considered as reality, with physical formalism into physical laws, the transformation of irregular observations, like in quantum mechanics, could then be regarded as probability potentiality (Jansen 2014).

Under the consideration of Heisenberg's uncertainty principle, two systems (such as a quantum particle and a detection device) are in superposition of physical states in Schrödinger's wave function. When they are joined, an interaction takes place, which reduces the superposed states into unique states, although they cannot be observed before a measurement is performed. Only after observing the outcomes, consciousness knows the experimental results (Bass 1971). Linear superposition in physical formalism allows the consideration of at least two or more physical states in superposition for the same time point, but there is no correspondence of the mathematical formalism with observable reality, since superposition has never been observed. This is essentially due to the mathematical treatment of time and space, as can be illustrated in the revisited thought experiment of Wigner's friend (Wigner, 1961).

Quantum mechanics and Wigner's friend thought experiment

The classical Wigner's friend example indicates that Wigner's friend performs a quantum mechanical experiment, when Wigner himself is absent from the lab. The question is, when does the wave function collapse, when the friend finishes the experiment or when Wigner himself comes back to the lab and obtains all information. Wigner pretends that superposition collapses in consciousness, first in the one of his friend and later in Wigner himself. However, if the friend was substituted by a material device, it would remain in superposition, only consciousness must be in either one state or the other and therefore induces the necessary collapse.

Wigner's friend thought experiment can be revisited for explaining some problems for the representation of time and space in quantum mechanics. The friend performs the experiment by

notifying the precise time coordinates and the pointer positions of the detection device at the beginning and the end of the experiment. The difference between the time points and the corresponding difference of the pointer positions are calculated and expressed as Δ time units and Δ pointer units, thereby the precise individual time coordinates and pointer units are reduced to calculated differences in arbitrary reference frames. When they are expressed as relations, Δ units / Δ time, they explain how many pointer units are acquired during one time unit. Thereby the units / time relation has become time invariant, which means that the precise starting and endpoints of an experiment are eliminated and that a future experiment will acquire new time coordinates, since only relations are maintained. Therefore, the calculated relation no longer indicates the present of the experiment nor its past and future, if it actually is or was or will be performed. Since scientific information is in general reduced to relational concepts (Baird 2013), it automatically looses any notion of the NOW, the past and the future (Jansen 2014). Nevertheless, since Wigner's friend performs the experiment, he has simultaneously the knowledge of both, the present with precise time coordinates and the time invariant relation.

The situation of Wigner himself is quite different, since he is lacking all information on time coordinates for the present of the experiment and only knows the unit / time relation established by experiences in the past. Thus, he can only partially imagine what really happens in the lab. Without precise time coordinates, he does not know the NOW nor the past and the future of the experiment, if it is actually performed, had been performed or will be performed. Thus Wigner's simple imagination of a physical experiment without any mathematical formalism already eliminates, present, past and future. As mentioned by Einstein "*... The distinction between past, presence and future is only an illusion, however persistent.*" (Jammer 2002, p 161). Any societal, religious or scientific law is a mental representation of an extra-mental regularity, which is necessarily time invariant. Therefore it cannot indicate the present, past or future, but when the law is applied again in extra-mental reality, a new NOW will be acquired.

With the known unit / time relation, Wigner can only imagine potential outcomes. By imagining the experiment, he had several possible outcomes in mental superposition with probability

estimations. At the moment, when Wigner enters the lab again and finds the experimental NOW and the final results, he has simultaneously two different informations, his imagined potential outcomes of several possibilities in superposition for the same time point and his friends reality result with only one outcome. In general, potentiality is assigned much less confidence than observed reality. Therefore the potential outcome has not to collapse, but is simply discarded as irrelevant, when observed reality is known. A probable but uncertain weather forecast has not to collapse either, when the real weather conditions are observed, it is simply discarded from further consideration. Quite naturally, reality is considered as more certain and potentiality as less certain and only probable.

Space is also differently perceived in reality and imagined potentiality. When Wigner was absent from the lab, he knew his own space location as a precise "HERE", but can only imagine the space of his friends lab as a less precise "THERE". However, during imagination, Wigner can switch instantly from his HERE to his friend's THERE, which resembles a kind of non-locality. Such a switch can even be much more rapid than the speed of light, for instance, when Wigner switches from his HERE to the Rover on Mars, which is actually working for him. This resembles Einstein's "spooky action at distance". Thus imagined potentiality has indeed the potency to travel faster than light, although this seems to be impossible in reality. Similar to imagined potentiality, linear superposition in the wave function of several locations for the same time point is identical to non-locality, however it is already included as a fundamental base in the formalism of quantum mechanics. Thus it is not surprising that Schrödinger's wave function can only lead to outcomes indicating non-locality.

Math-reality correspondence in quantum mechanics

Like classical physics quantum physics lost the notions of past, present and future, but there are additional changes. Schrödinger's wave function allows the linear superposition of even contradictory physical states, like a living and dead cat in Schrödinger's famous thought experiment. However, the philosophical concept of reality cannot allow the simultaneous presence of contradictory events. Already Aristotle wrote " *... it is impossible for the same thing to belong and not to belong to the same thing at the same time.*" (Gottlieb 2011, p.

3/14), which is known as the law of non-contradiction for the same time point.

In contrast, superposition of contradictory events is possible in mental potentiality. If in reality only one president can occupy the White House, several Presidents can be mentally imagined in potentiality to occupy the White House, before the election is finished. Since only potentiality can superpose contradictory events, Schrödinger's wave function, illustrated by a simultaneous living and dead cat, cannot represent reality, but only mental potentiality.

Extra-mental reality and mental potentiality have completely different properties. Observable reality is limited to the present, when there is direct contact between extra-mental reality and its mental representation through all sensory organs. However, if sense organs become inactive, as with closed eyes, the direct contact to extra-mental reality is lost, then past and future events can be imagined with the help of memorized observations (Jansen, 2014). Under the condition that past observations were regular, they can be extrapolated into the future with great certainty and represent expected reality. However, irregular observations, as in quantum mechanics, only allow an extrapolation in the future with uncertain probability estimations, which precisely corresponds to mental potentiality.

Conclusion

One weird aspect of quantum mechanics is based on linear superposition of contradictory physical states in Schrödinger's wave function, which led to Everett's multi-world interpretation (Everett 1957) or to environmental decoherence (Zurek 1981). The philosophical law of non-contradiction does not allow considering superposition of multiple events in extra-mental reality for the same time point. Nevertheless, mental potentiality in the mental representation of extra-mental reality can allow predictions of the future, but only with probability estimations (Jansen 2008). The interpretation of the wave function as physical reality would be an ontological interpretation, which holds the physical formalism as a direct description of nature's behaviour. In contrast potentiality would be an epistemic interpretation with limited knowledge on extra-mental reality. Nevertheless, the behaviour of nature can be

approached to a considerable degree with mathematical models based on superposition and probability.

The interpretation of quantum mechanics as reality or potentiality remains neutral with respect to philosophical or religious world views, which can neither be confirmed nor refused. The reality or potentiality interpretation of quantum mechanics does not change its intrinsic properties of uncertainty and probability, they are only attributed to different realms either to extra-mental reality or to its mental representation. Quantum mechanics as the most fundamental concept of the physical universe have to be considered when explaining the beginning of the universe. Thus either reality or potentiality could be the starting point of the universe and considered as primary.

The primacy of reality or potentiality essentially depends on the underlying world view, which differs in western and eastern countries. Western science is essentially based on the reality interpretation, by considering physicalism as the dominating concept followed by Darwin's evolution of life as random genetic mutations and environmental selection. To the contrary, religions are essentially based on potentiality by attributing the creation of the universe by a design to an omnipotent, eternal God. Eastern Vedanta philosophy would also expect potentiality as the main characteristic of a prior existing consciousness-as-such (purusha), responsible for the creation of the physical universe (Rao 2005).

Potentiality is a normal mental function allowing creation by first designing and then realizing the design in extra-mental reality. However, a fundamental condition for any creation is the presence of prior knowledge, which allows a preview of the final construct thereby avoiding major errors during its construction. In humans, knowledge arises only progressively and is still absent in the young child, so that potentiality becomes a secondary mental function based on acquired experience. The question on primacy of reality or potentiality in quantum mechanics cannot be experimentally solved. Nevertheless, the reality interpretation has some weird aspects, which are completely lacking in the potentiality interpretation. Although the primacy question depends on the world view, potentiality will always remain completely different from reality. Thus potentiality can be considered as a probabilistic mental model for predicting extra-mental reality and can be

expressed in the form of imagined prediction or mathematical modelling, like quantum mechanics.

References

Baird, P. (2013). Information, universality and consciousness: a relational perspective. *Mind and Matter*, 11.1, 21-43.

Bass L. (1971) The mind of Wigner's friend, *Hermathena, cxii*,

www.fredalanwolf.com/myarticles/Bass_1.pdf

(1975) A quantum mechanical mind-body interaction. *Foundations of Physics.* 5.1, p.159,

Einstein, A.,Podolsky, B. and Rosen, N. (1935) *Phys. Rev.* 47, 777 .

Everett H. (1957) Relative state formulation of quantum mechanics. *Reviews of Modern Physics* 29: 454-462.

Gottlieb P. (2011) Aristotle on Non-contradiction. *Stanford Encyclopedia of Philosophy*

http://plato.stanford.edu/entries/aristotle-noncontradiction/

Heisenberg, W. (1927) Über den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik. *Zeitschrift für Physik,* 43, 172-198

(English translation in Weeler and Zurek, 1983, 62-84)

Jansen, F.K. (2008). Partial isomorphism of superposition in potentiality systems of consciousness and quantum mechanics. NeuroQuantology, 6.3, 278-288.

Jansen, F.K. (2014) The Observer's Now, Past and Future in Physics from a Psycho- Biological Perspective. *Cosmology* 18, 376 - 401. http://cosmology.com/ConsciousTime112.html

Jammer M. (2002) Physics and Theology. Princeton University Press,

"The separation between past, present and future is only an illusion" (Einstein 1955, p.161).

Rao, K.R. (2005). Perception, cognition and consciousness in classical Hindu psychology.

J. Consciousness Studies, 12.3, 3-30.

Schrödinger, E. (1926). "An Undulatory Theory of the Mechanics of Atoms and Molecules". *Physical Review* 28 (6): 1049–1070.

Tegmark M. (2014) *Our Mathematical Universe: My Quest for the Ultimate Nature of Reality.* Knopf A., New York.

Wigner, E. (1961): "Remarks on the Mind-Body Problem", in *The Scientist Speculates*, I. J. Good, ed. pp. 284-302, Heinemann, London (1961);

Zurek, W.H. (1981) Pointer basis of quantum apparatus: into what mixture does the wave packet collapse ? *Phys Rev,* D24, 1516-1525